PORT PLASTICS

Semiconductor

A GROWING PROBLEM
THE EFFECTS OF MOISTURE ON PLASTICS

No doubt, if you machine plastic parts, you have been faced with the effects of moisture absorption. Moisture absorption is defined as the ratio of the weight of water absorbed by a material to the weight of the dry material. Essentially you evaluate and characterize materials based on their sensitivity to water. The higher the moisture absorption, the more sensitive the material is to changes in mechanical, electrical, and, in the case of this article, holding dimensions. Moisture absorption is measured using ASTM D570 and is often expressed as a 24-hour value and a full saturation value. The test is an immersion test where the specimen is thoroughly dried prior to immersion to determine the level of moisture uptake.

SO WHAT EXACTLY IS HAPPENING TO MAKE SOME MATERIALS MORE HYDROPHILIC?

There are two mechanisms by which plastic material will absorb anad maintain moisture:

1. **Micro Porosity** – here, nano-sized pockets created from the polymer shape can absorb moisture. Here the water exists within a free state. Once the moisture penetrates the polymer matrix, the moisture condenses into a liquid phase. This represents more than 90% of the moisture in a typical polymer.
2. **Immobilized Moisture** – since water molecules tend to form hydrogen bonds, water may chemically react with the polymer making a non-free state. This is less common and depends on the chemistry of the polymer chain or fillers.

The rate of moisture absorption can be accelerated by increasing the temperature. While the rate of moisture absorption will increase the materials' rate of reaching saturation, known as thermal spiking, the capacity at saturation will not change significantly.

Managing moisture absorption for dimensional machined tight tolerance parts can be challenging. Certainly, selecting a material that is low in moisture uptake is helpful but not always the best material choice overall. Extra care should be taken with post-cured materials as part of their manufacturing process or annealed to reduce stress. In such cases, the plastic specimen will start the machining process extra dry, allowing for more growth to equilibrium. Starting with a plastic specimen at equilibrium to room temperature conditions will minimize changes over time.

Moisture Absorption @ Saturation (%)

	Moisture at Saturation
Nylon	7%
PET	0.90%
PVDF	0.05%
Delrin Acetel	0.09%
PPS	0.03%
PEEK	0.50%
Ultem 1000	1.25%
PTFE	0.01%
PVC	0.40%
Polyimide unfilled	1-1.3%
PAI (Torlon)	1.70%

IF YOU HAVE ANY QUESTIONS ABOUT THE MOISTURE CHARACTERISTICS OF MATERIALS USED IN SEMICONDUCTORS OR NEED HELP OPTIMIZING YOUR PRODUCT SELECTION, CONTACT YOUR LOCAL PORT PLASTICS SALES OFFICE!

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